

# Environmental Windows and the Endangered Species Act: Protecting Anadromous Salmonids in the Pacific Northwest



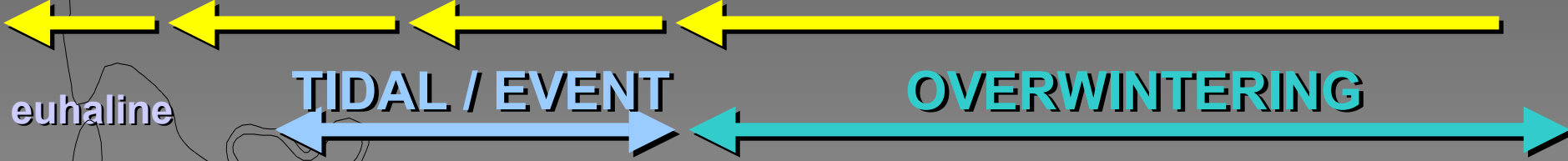
**Charles (“Si”) Simenstad**

Wetland Ecosystem Team  
School of Aquatic and Fishery Sciences  
University of Washington

# **CHALLENGES THAT ANADROMOUS SALMONIDS POSE TO THE USE OF ENVIRONMENTAL DREDGING WINDOWS**

- **Extremely diverse use of tidal freshwater, estuarine and nearshore marine environments as juveniles; often extended residence**
- **Vulnerable early life history stages: physiologically sensitive, susceptible to predation, often highly selective feeding → behaviorally constrained to certain habitats and conditions**
- **Documented sublethal responses to estuarine contaminants**
- **Less vulnerable as adults; more focused in time and space; often very short exposure, but delay can be consequential**

# ANADROMOUS PUNCTUATED MIGRATION



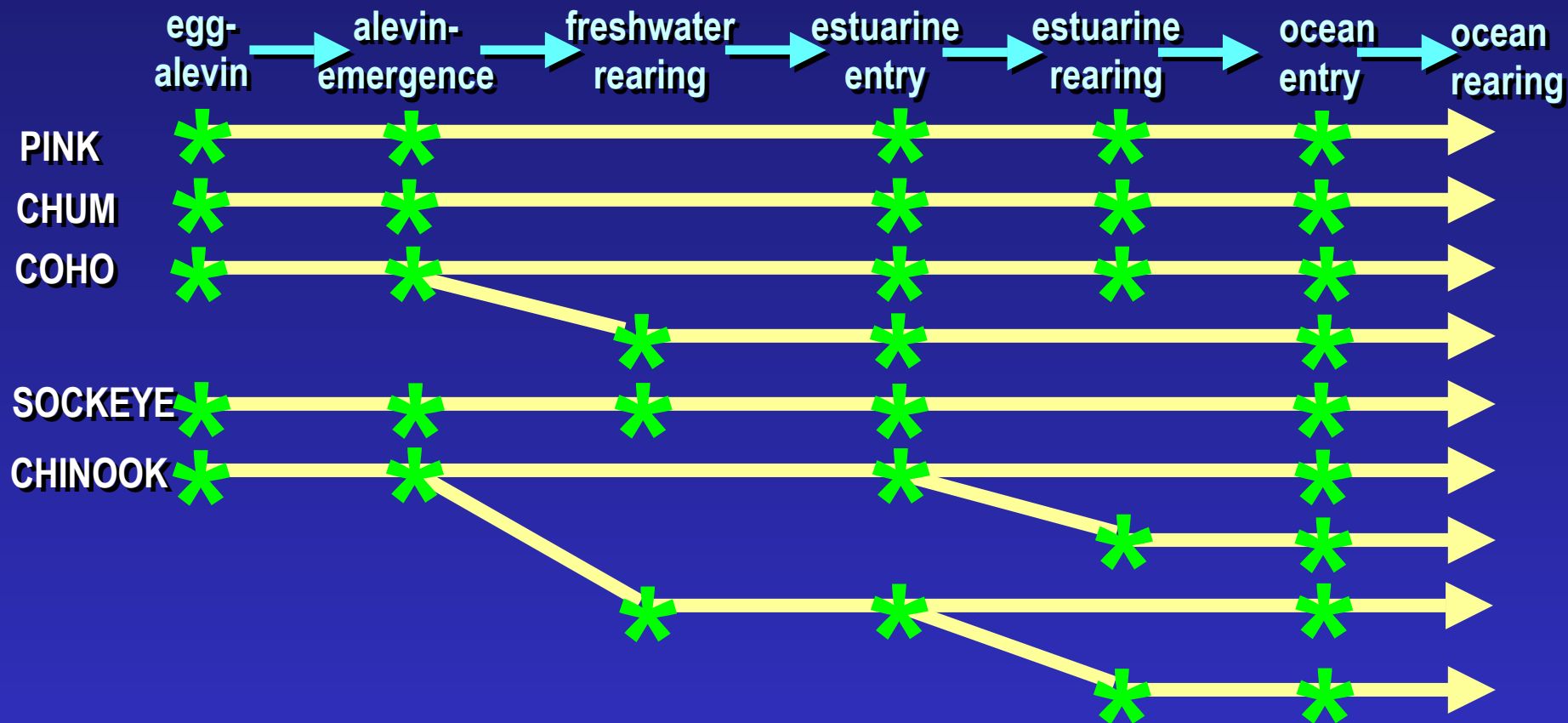
euryhaline

oligohaline-brackish

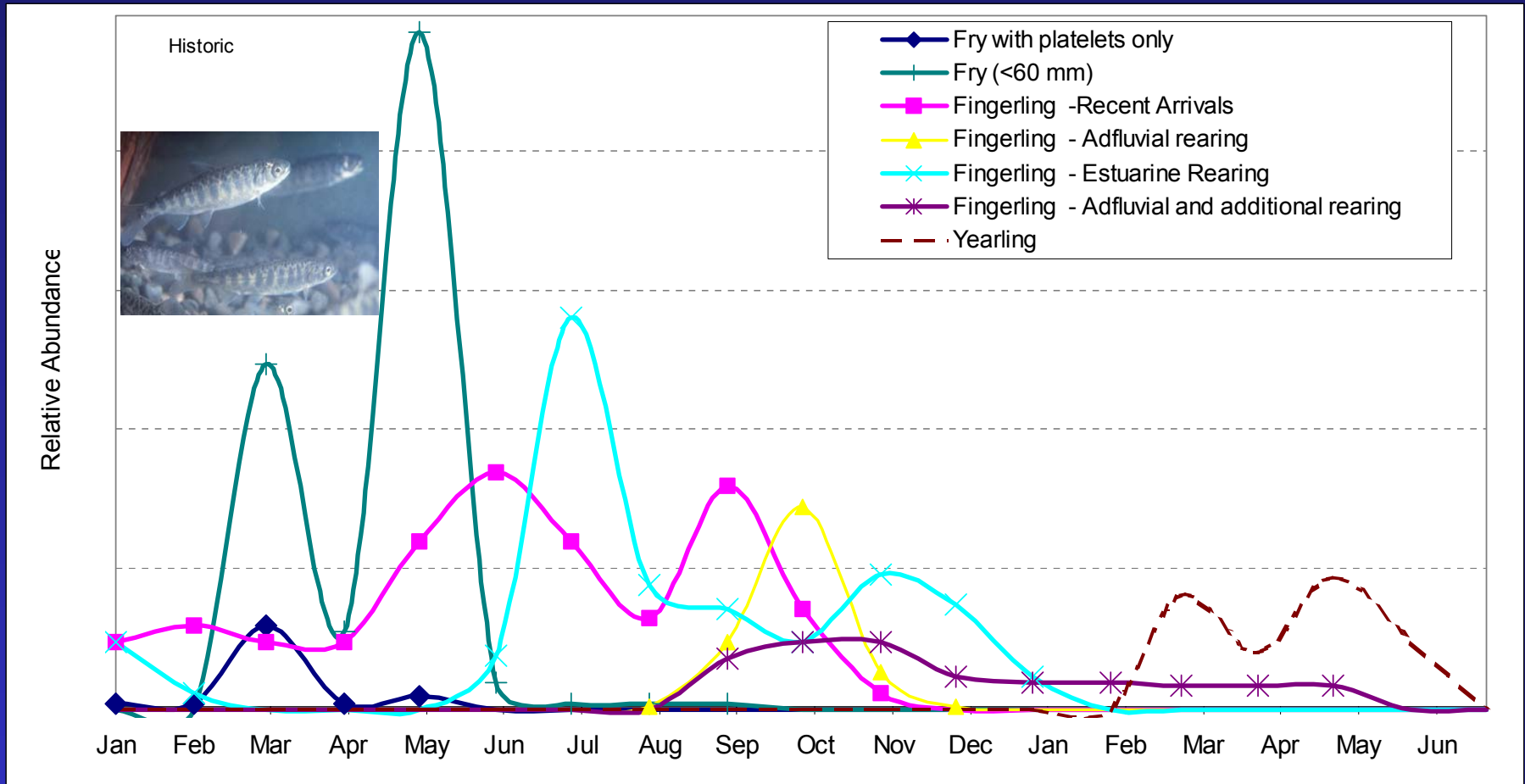
tidal freshwater



# FOR PACIFIC SALMON, SPECIES AND LIFE HISTORY DIVERSITY INTEGRATES WATERSHED, ESTUARY AND COASTAL HABITAT USE



# EXAMPLE OF DIVERSE TIMING AND RELATIVE ABUNDANCE DURING ESTUARINE MIGRATION OF JUVENILE PACIFIC SALMON



**Historic early life history types for one-brood year of chinook salmon in the Columbia River estuary, based on historic sampling throughout the lower estuary by Rich (1920); from Bottom *et al.* (in press)**

# **DREDGING WINDOW “COMPLICATIONS” IN THE PACIFIC NORTHWEST**

- Increasing ESA threatened - endangered salmonid populations (ESU)....any take becomes legally and politically unacceptable
- While inner estuaries generally reflect unique stock run timing and diversity, estuarine complexes and nearshore marine waters are mixing zones
- Salmon from hatcheries dominate runs in case of some species and watersheds, and are primary target of fisheries, but hatchery fish are not necessarily analogous to wild fish and much of science about juvenile salmon behavior is based predominantly on hatchery salmon
- Northwest native indian tribes have investment in specific stocks and co-management rights and responsibilities

# COMMON DREDGING ISSUES WITH ANADROMOUS SALMONIDS

## Acute Mortality

- entrainment
- extreme degradation in water quality (D.O.)
- release of lethal contaminants

## Indirect - Sublethal

- migration blockage
- increased vulnerability to predation
- exposure to contaminants
- reduce foraging efficiency

## Ecosystem Change

- change in estuarine circulation
- alter salinity distribution
- increased water velocities
- reduction in essential habitat (e.g., seagrasses)
- food web changes



# **Application of Environmental Windows to Limit Dredging Impact on Juvenile Salmon**

- Direct vulnerability to dredging plumes
  - juvenile salmon are surface oriented, and most vulnerable stages (fry) behaviorally restricted to shallow water (ESA-listed PS salmon are “ocean-type”!)
  - likely more vulnerable in brackish regions of estuaries where they are undergoing smoltification process
  - avoid turbidity
  - have evolved in turbid ecosystems; turbidity reduces predation (Gregory and Levings 1998) and can enhance feeding efficiency
  - depends upon extent of impingement of migratory corridors and rearing habitat requirements
- Very dependent on salmonid population structure
- Highly sensitive to “landscape context” of salmon use of estuarine and nearshore marine habitats



# Washington State (WDFW)

## Dredging Regulations (WAC)

- *“Dredging projects shall incorporate mitigation measures as necessary to achieve no-net-loss of productive capacity of fish and shellfish habitat.”*
- **Technical provisions:**
  - **timing limitations (environmental windows)**
  - observation of fish kill or fish in distress, dredging shall immediately cease
  - hydraulic dredge only operated with intake at or below the sediment surface; and only raised maximum of 1 m above bed for brief periods
  - no stockpiling--each pass of a clam shell dredge bucket shall be complete
  - BMP--dredging conducted with dredge types and methods that cause the least adverse impact to fish and shellfish and their habitat
  - dredged material shall be disposed of at approved in-water disposal sites or upland; beneficial uses may be allowed
  - conducted to a depth not greater than channel depth at seaward end of channel
  - prohibited in herring spawning beds and in rockfish and lingcod settlement and nursery areas
  - kelp adversely impacted due to dredging shall be replaced
  - avoid adverse impacts to eelgrass

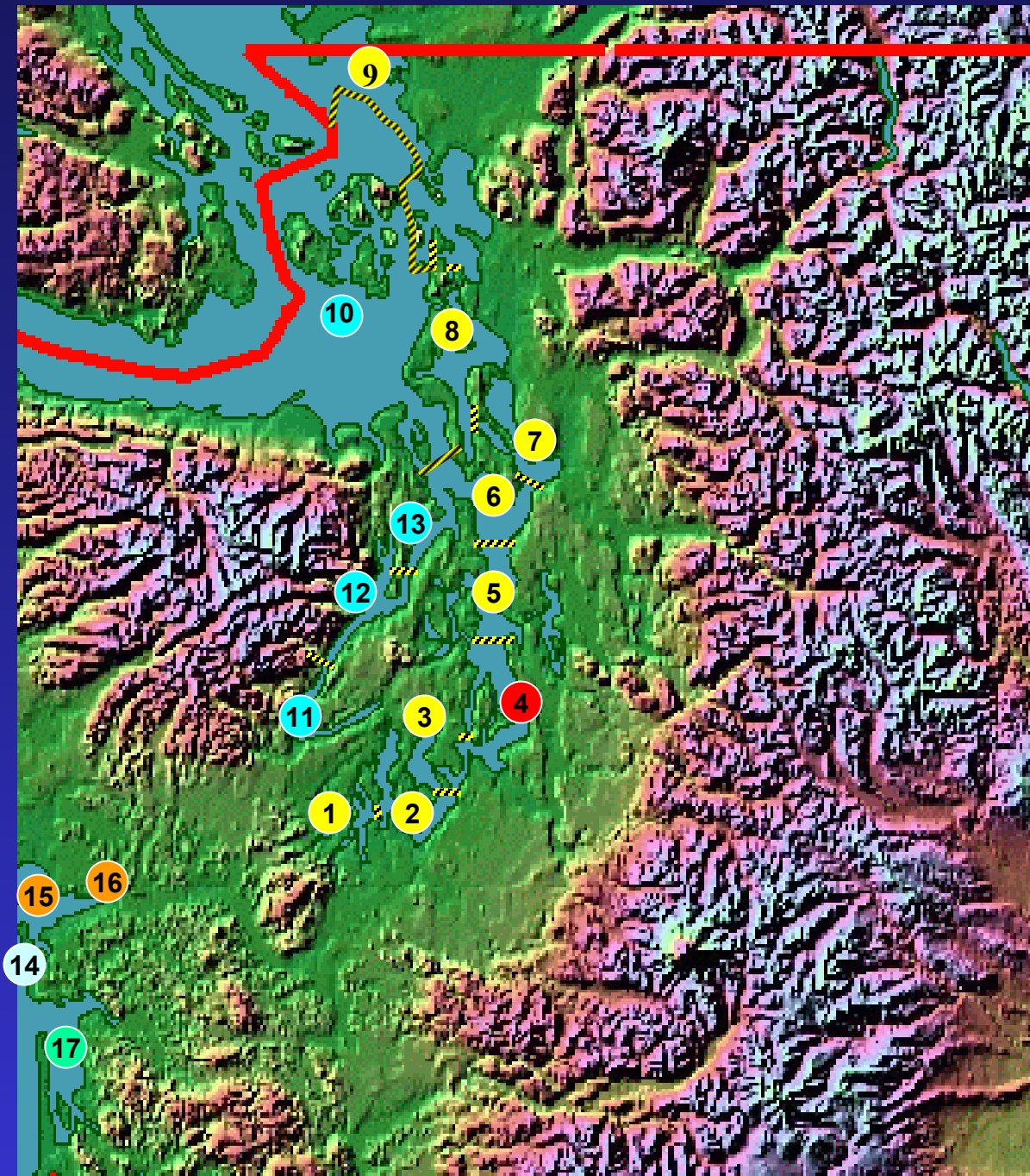
# **TECHNICAL BASIS FOR JUVENILE SALMON ENVIRONMENTAL WINDOWS**

- **90%-100%run timing protections for broad areas**
- **data from fry-smolt trapping in rivers and beach seining in marine nearshore waters (local area habitat biologists++)**
- **geographic groupings represent areas with roughly equivalent timing windows**
- **ultimately, still comes down to best professional judgement (of area habitat biologists)**

# TIDAL REFERENCE AREAS

Washington State Department of  
Fish and Wildlife

Geographic areas of  
Puget Sound and  
coastal Washington  
State estuarine and  
marine nearshore  
waters that are  
considered to reflect  
discrete population  
differences in juvenile  
salmon outmigration  
timing and intensity



- 1 Area A
- 10 Area B
- 14 Area C
- 15 Area D
- 17 Area E

# CURRENT ENVIRONMENTAL WINDOWS FOR DREDGING IN WASHINGTON STATE

Tidal Reference Area	Juvenile Salmon Migration, Feeding and Rearing	Surf Smelt Spawning Habitat	Herring Spawning Habitat
1	Mar. 15-June 14	---	Jan. 15-Mar. 31
2	Mar. 15-June 14	July 1-Mar. 31	Jan. 15-Mar. 31
3	Mar. 15-June 14	Oct. 1-April 30	Jan. 15-Mar. 31
4	Mar. 15-June 14	Oct. 1-April 14	Jan. 15-April 14
5	Mar. 15-June 14	Sept. 1-Mar. 31 excp.	Jan. 15-April 30
6	Mar. 15-June 14	---	---
7	Mar. 15-June 14	Year around	Feb. 1-April 14
8	Mar. 15-June 14	Year around	Feb. 1-April 14
9	Mar. 15-June 14	Year around	Feb. 1-April 14 excp.
10	Mar. 15-June 14	Sept. 15-Oct. 31	Jan. 15-April 30
11	Mar. 15-June 14	Sept. 15-Mar. 1	Jan. 15-March 31
12	Mar. 15-June 14	---	Feb. 15-April 14
13	Mar. 15-June 14	Oct.15-Jan. 31	Jan. 15-April 14
14	Mar. 1-June 14	---	---
15	Mar. 1-June 14	---	---
16	Mar. 1-June 14	---	---
17	Mar. 1-June 14	---	Feb. 1-Mar. 14

# PROPOSED REVISIONS TO ENVIRONMENTAL WINDOWS

## Tidal Reference Area

## Timing Option 1 (based on AHB recommendation)

## Timing Option 2 (geographic grouping)

1	Feb. 15 - July 31	Area A - Feb. 15 - July 31 (Aug. 15)
2	Feb. 15 - July 31	A
3	Feb. 15 - July 31	A
4	Feb. 15 - July 31 (Sept. 10) Jan. 15 - July 31 (Sept. 10)	A
5	(Lower Duwamish R. to upper turning basin- dredging 1/15-10/15)	A (Lower Duwamish R. - dredging - Feb. 1 - Oct. 15)
6	March 15 - July 15	A
7	Jan. 15 - July 31 (8/14) (Lower Snohomish R.- dredging 1/15 - 9/30)	A (Lower Snohomish R. - dredging - Feb. 1 - Sept. 30)
8	Feb. 15 - July 15	A
9	March 15 - Sept. 30 (Cherry Pt. 3/15 - 7/31)	A (Cherry Pt. 3/15 - 7/31)
10	Feb. 15 - June 30 (July 15) (Straits 2/15 - 7/15?)	Area B - Feb. 15 - July 15 (July 31)
11	Feb. 15 - July 15 (July 31)	B
12	Feb. 15 - July 15 (July 31)	B
13	Feb. 15 - July 15 (July 31)	B
14	March 1 - June 15 (Lower Quillayute R.- 3/1 - 9/15)	Area C - March 1 - June 15 (Lower Quillayute R. - 3/1 - 8/15)
15	Feb. 15 - June 15	Area D - Feb. 15 - June 15
16	Feb. 15 - June 15	D
17	March 1 - Sept. 1 (9/15)	Area E - March 1 - Sept. 1

# ALTERNATIVES TO GENERALIZED ENVIRONMENTAL DREDGING WINDOWS

- **System Specific:** use location-specific (estuary/geographic region) data to adapt dredging windows to variability in local/regional populations
- **“Dredging Influence” Monitoring:** assess intensity and scope of stressors; presumes behavioral capacity of fish to avoid, e.g., higher resolution windows, such as flood tide
- **Real-Time Monitoring:** detect significant presence and vulnerability by actual fish detection and relative enumeration

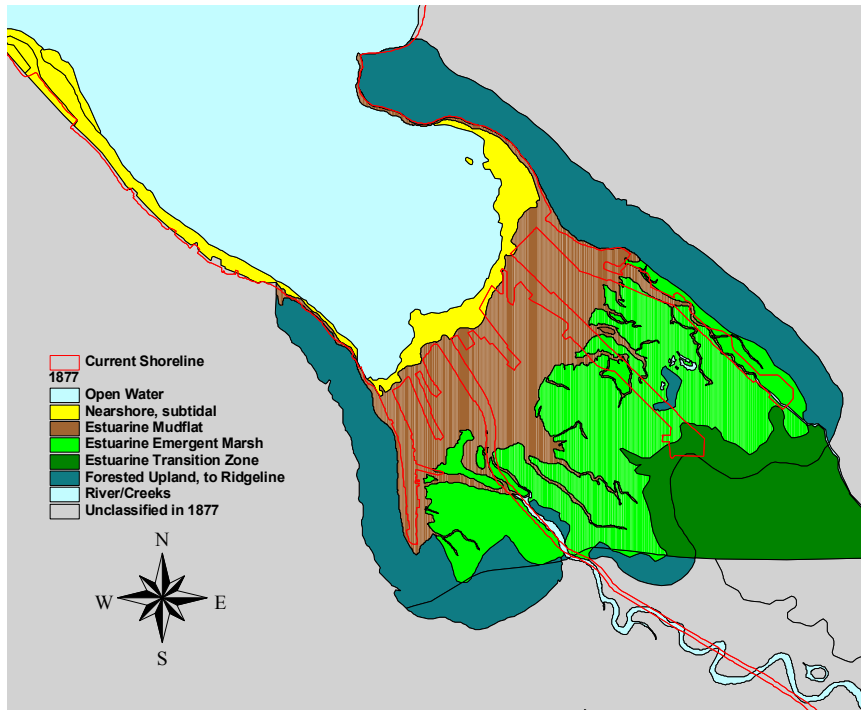


# SYSTEM SPECIFIC APPROACH TO ENVIRONMENTAL DREDGING WINDOWS

- Commencement Bay Superfund remediation dredging of contaminated waterways
- More Bay-specific information on juvenile salmon occurrence and distribution in the Bay (Puyallup Tribe), WDFW and allowed **February 15-August 15** exclusion to **February 15** through **July 15** (conditioning work **July 16** through **July 31** on project specific actions).
- Based on EPA needs to remove contaminated sediment and conduct remediation, WDFW recently approved two prohibited in-water work windows appropriate for dredging activity based on the risk (gill abrasion, turbidity, direct toxicity) posed to juvenile salmonids:
  - Contaminated sediment window: August 15-February 14
  - Clean sediments window: July 16-February 14 (with conditions for July 16-July 31)
- Other conditions for pile driving or treated wood removal

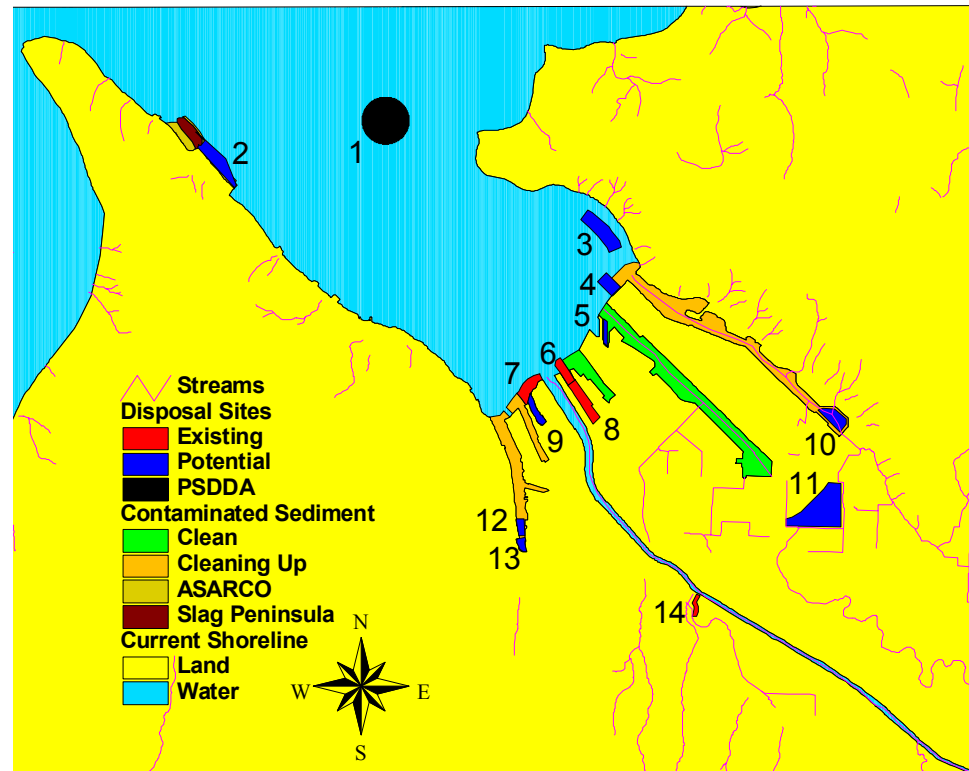


# Current/Historic Shoreline



## Commencement Bay (Puyallup River Estuary) Puget Sound, Washington (USA)

### Disposal Sites and Contaminated Sediments



# SYSTEM SPECIFIC APPROACH TO ENVIRONMENTAL DREDGING WINDOWS

Based on review of project specific actions, project location and existing data of juvenile salmonid use in Commencement Bay, work may be permitted from **July 16** through **July 31** only under the following conditions:

*Construction activity shall occur no more than **12 hours** in any **24 hours** period and no more than **5 days** in any **7 day** period, if construction limited to minor excavation/limited impacts (i.e., channel in St. Paul habitat area) and:*

- 1) construction occurs in limited period of time.*
- 2) baseline HPA conditions (i.e., limit work as much as possible in the dry, use silt curtains, suction dredge whenever possible)*



# **RESEARCH GAPS**

- 1. More complete documentation of salmonid population structure relative to windows of vulnerability in estuary and nearshore**
- 2. Behavioral responses to dredging turbidity, noise, physicochemical and other near-field influences**
- 3. Better understanding of critical points in estuarine landscape for juvenile salmonids**
- 4. Individual and population significance of non-lethal responses—delay, exposure to predators, etc.**
- 5. Extent of mixing of populations in receiving nearshore marine waters**
- 6. Relationship to contaminant exposure and delayed, sublethal injury**